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CFD Model of Water Droplet Transport for ISS Hygiene Activity

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Abstract

The goal of the study is to assess the impacts of free water propagation in the Waste and Hygiene Compartment (WHC). Free water can be generated inside the WHC in small quantities due to crew hygiene activity. To mitigate potential impact of free water in Node 3 cabin the WHC doorway is enclosed by a waterproof bump-out, Kabin, with openings at the top and bottom. At the overhead side of the rack, there is a screen that prevents large drops of water from exiting. However, as the avionics fan in the WHC causes airflow toward the deck side of the rack, small quantities of free water may exit at the bottom of the Kabin. A Computational Fluid Dynamics (CFD) analysis of Node 3 cabin airflow made possible to identify the paths of water transport. The Node 3 airflow was computed for several ventilation scenarios. To simulate the droplet transport the Lagrangian discrete phase approach was used. Various initial droplet distributions were considered in the study. The droplet diameter was varied in the range of 2-20 mm. The results of the computations showed that most of the drops fall to the rack surface not far from the WHC curtain. The probability of the droplet transport to the adjacent rack surface with electronic equipment was predicted.